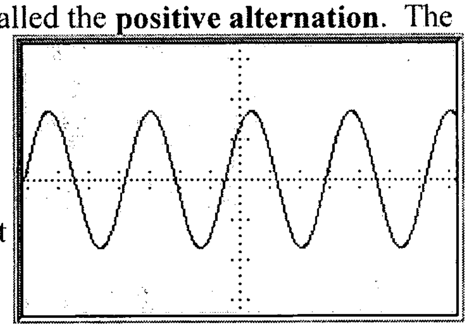
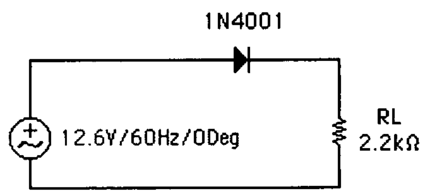
First, in order to understand how a rectifier works, you must have a general knowledge of the diode. The diode is made up of semiconductor materials, like silicon or germanium. One side is made of a P-type material, and the other an N-type material forming a junction in this middle, thus forming a PN Junction Diode. The P-type side is called the **anode**, while the N-type is the **cathode**. The diode can be used to block current in one direction, and conduct it in the other. This is called **biasing**. There are two biasing conditions, forward biased and reverse biased. When the diode is forward biased, it conducts current, when reverse biased, it blocks current. In order to forward bias a diode, you must make the anode more positive than the cathode, to reverse biase, you must make the anode more negative than the cathode. Don't worry, it will all come together soon.

Purpose of the Rectifier.

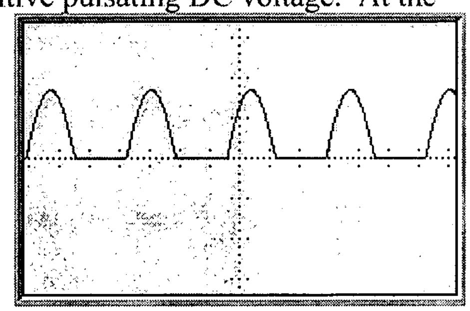
On the left you see a sine wave as seen on an oscilloscope. Sine waves consist of 360 degree cycles. You can see how the wave curves in the upward direction, and then down past the middle into the downward direction. The curve in the upper portion of the wave is called the **positive alternation**. The curve in the lower half of the wave is call the **negative alternation.** Each alternation is 180 degrees of the complete cycle. The very top and bottom of each alternation is called the **peak.** You have a negative peak and a positive peak. Now if you were to look at a DC voltage on the oscilliscope, you would see a straight line going across. This is where the rectifier comes it. It's purpose is to turn that sine wave you see above, into as close to a straight line as possible, or, conver an AC signal into a pulsating DC. Go to the next page to see how this works.



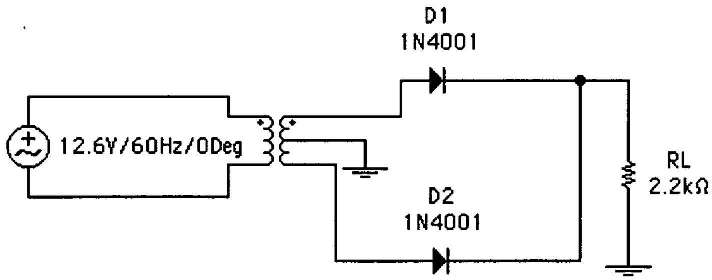
Half-Wave Rectifier



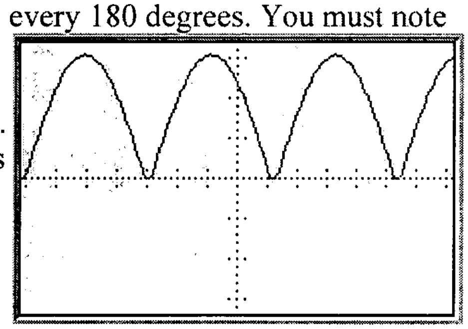
On the left is the schematic for a half-wave rectifier circuit. This is the most simple of the rectifier circuits. Also, the least efficient. With this circuit you can only recover 180 degrees of the the full cycle. As you can see, the anode is pointing toward the voltage source. This will result in a positive pulsating DC voltage. At the right is an example of this. It's really quite a simple concept when you think of it! If you recall the sine wave on the previous page, this looks the same, except the negative alternations are missing. This is easily explained. Imagine that you could stop time every alternation. We'll start with the positive. As the positive alternation approaches the diodes anode, the anode becomes more positive than the cathode, causing the diode to be forward biased. As this alternation goes through the diode, the measurement line goes up! You can see this in the image.



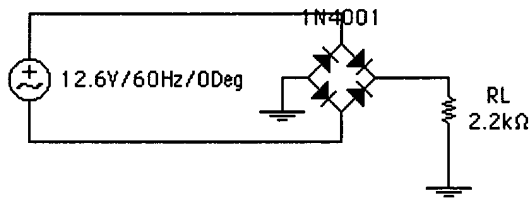
Now as time permits the second alternation to go by, we'll see a change. This is the negative alternation. Now, as the negative alternation approaches the diode's anode, it causes the anode to be more negative than the cathode, thus reverse biasing the diode. When the diode is reverse biased, it blocks the current. You can see this as the straight lines between positive alternations. This is the basic idea of the half-wave rectifier! See how easy it is! Now, I'm sure you're thinking that this seems like a waste, after all, we are wasting half of the cycle! Never fear! The answer lies on the next page!



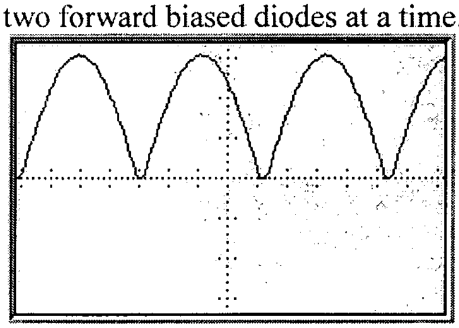
As you can see, this circuit is a little more complex than the half-wave. This circuit requires the use of a centre tapped transformer. You may also notice that this circuit contains two diodes! There is a simple reason for this, efficiency! Now, how is an extra diode going to make a rectifier more efficient? I'll tell you how! But once again you must imaging that we could stop time every 180 degrees. You must note that the bottom of the transformer's secondary is 180 degrees out of phase with the top. Which means, as the top of the secondary is in the positive alternation, the bottom half is at the negative alternation. So, how does it work? Well, when the top of the secondary produces the positive alternation, the anode becomes more positive than the cathode. You got it! It forward biased the diode! You can see this in the image as the first alternation. Now, at the same time the bottom half of the secondary is in the negative alternation, making D2 reverse biased, allowing no current. So how does that second positive alternation get there? Well, now for the next alternation. The top of the secondary goes into it's negative alternation, causing the anode to be more negative than the cathode, causing the diode to become reverse biased. At the same time, the bottom half of the secondary goes through it's positive alternation. Just like above, it causes D2's anode to be more positive than it's cathode, forward biasing it, causing the second positive output alternation! Thus recovering all 360 degrees of the cycle!! Now it's time to get fancy with them!



Bridge Rectifier



Once again, we have another "trickier" rectifier. As you see, the bridge rectifier has 4 diodes. A transformer is optional. Now, what's the purpose? Well, once again efficiency! IF you recall the full-wave, the transformer was centre-tapped, so the pulsating DC output is only half the voltage from the transformer. (I.E.- Vin=12.6Vrms, Vout=6.3Vrms) In the bridge rectifier, you only lose 1.4V across the two forward biased diodes at a time. As you can see, the output waveform looks just like the full-wave.



Well, the bridge rectifier is a full-wave rectifier....... with a slight difference. See, when the Voltage source is on the positive alternation, two diodes are being forward biased. Looking at the schematic on top of the page, we'll say that the upper left diode is D1, the upper right is D2, the lower right is D3, and the lower left is D4. I would have labeled them, but the program I have would not let me label the individual diodes on the bridge. Anyway........... During the positive alternation, D2's anode is more positive than its cathode causing it to be forward biased. At the same time, D4's anode is more positive than its cathode, causing it to be forward biased! This is the first alternation you see on the waveform. Now during the negative alternation, D1 and D3's anodes are more positive than their cathodes, causing them to be forward biased. Therefore causing the second positive output alternation. This concludes our lesson on rectifier's.

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